REMARKS

This amendment is submitted in response to the Office Action mailed on December 23, 2005 and is accompanied by a Petition for Three-Month Extension of Time to extend the due date to 23 June 2006. Applicant has considered the Office Action in the above-captioned application and requests reconsideration of the claims in light of the amendments and remarks presented herein.

I. SPECIFICATION OBJECTIONS

The specification was objected to because of various informalities. Paragraphs beginning at line 2 of page 1, line 7 of page 1, and line 21 of page 3 have been amended as suggested. Withdrawal of the specification objections is respectfully requested.

II. REJECTIONS UNDER 35 U.S.C. § 112

Claims 1-16 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant respectfully traverses these rejections.

Applicant's specification on pages 1-2 bridging makes clear that insulating walls 13 together with support electrode 11 and membrane 12 serve to define a (cMUT) cell as pointed out in the Office Action. Also, the (cMUT) cell in the present invention shown in the embodiment of Figure 2 includes an isolation post 18 which replaces the isolation layer 14 of a prior art in Figure 1, to prevent shorting while limiting the accumulation of charge. And further, the specification on pages 3-4 bridging shows that a cMUT with multiple cells is formed by support electrode 21 (e.g., silicon wafer according to one embodiment), membrane electrode 28, and insulating walls 22 (e.g., thermal oxide according to one embodiment). The insulating walls 22 in the embodiment of Figures 3A-3G are formed from a layer of thermal oxide grown and patterned using convention photolithography, and etched to define the wells 23. The isolation posts or areas 24 are also shown in Figures 3A-3G.

Even though the insulating walls 22 in the examples may at first appear to have some similarity to isolation posts or areas 24 due to the cross-sectional view of the Figures 3A-3G, upon closer inspection they are clearly not support 'posts' as suggested in the Office Action. The peripheral wall portions of 22 of the cMUT and the portions of 22 in the middle are both

insulating walls defining the wells 23 and the cavity. Also, 'at least one cavity' means that the capacitive ultrasonic transducers with isolation post can have one cavity or more as shown in Figure 2 and Figure 3. Further, the 'area' recited in claim 3 and 4 does not designate pure space or locale as suggested by the Office Action, but specifically corresponds to the isolation posts or areas 24 that can be carried by a support electrode or membrane electrode. The word 'area' is used because it can be patterned to have any size and shape, and to emphasize that the post need not have any particular size, shape, or cross-sectional outline, in other words the post like structure need not just the shape of a circular, rectangular, or other regular or irregular polygon shaped post.

Claim 1, 5, and 15 were amended to add punctuation and alter word order to help the reader understanding the claim, while retaining the previously recited elements. Claim 3 was amended to show the antecedence of the support 'electrode' in claim 1. Accordingly, applicant respectfully disagrees with the examiner's characterization of the claims as indefinite. Considering the claims as a whole, along with the specifications, the claims particularly point out and distinctly claim the subject matter which applicant regards as the invention.

III. REJECTION UNDER 35 U.S.C. § 103

Claims 1-2, 4, 7-9, 12-16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Haller et al (US 519476, hereinafter "Haller") in view of Schindel et al (US 5287331, hereinafter "Schindel"), alone or further in view of Stamm (US4192977).

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Haller in view of Schindel, alone or further in view of Stamm as applied to claims 1 or 2 above, and further in view of Djuric (US4070741).

Claims 3, 5-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haller in view of Schindel, alone or further in view of Stamm as applied to claims 1 or 2 above, and further in view of Muggli et al (US4081626, hereinafter "Muggli").

Applicant respectfully traverses for the following reasons.

A. THE CITED PRIOR ART

Haller teaches fabrication and structure of an electrostatic ultrasonic transducer. The transducer comprises a substrate 11 which forms one plate of a capacitor and a membrane including a nitride layer 13 and gold contact layer 14 forming the other parallel plate of the capacitor. The membrane is supported by the remaining thermal oxide 12. (Col. 3, line 42-47). The microscopic grooves in the plate act as resonators to determine the frequency response of the ultrasonic transducers. (Col. 1, line 56-61).

Schindel shows an air coupled ultrasonic transducer structure. The invention has a rigid conducting backplate 1, a thin dielectric layer 2, a thin conducting upper electrode 3, and random surface contours 4 on one side of backplate 1. The surface contours 4 serve to introduce air pockets between backplate 1 and the dielectric layer 2. The dielectric layer 2 allows electrical isolation between backplate 1 and upper electrode 3. (Col. 3, line 6-18).

Stamm teaches a highly directional ultrasonic electret transducer structure. The counter-electrode 6 is arranged at a small distance from the diaphragm 5 and it is provided with projections 11, which touch with their tips against the electret diaphragm 5. In this way, the diaphragm is subdivided into a system of partial diaphragms. (Col. 3, line 50-54).

Djuric shows an electret acoustic transducer structure. The transducer has a thin, low mass diaphragm 11 which is supported in close proximity to a backplate 13. The separators 15 are conventionally designated as posts. The electret layer 36 on top surface of the backing plate prevents shorting the transducer capacitance. (Col. 3, line 60-64).

Muggli teaches an electrostatic transducer having narrowed directional characteristic. With a very smooth, highly polished surface backplate, the frequency range extends to 500kHz although the sensitivity is rather low. With a surface roughened by sandblasting, or provided with grooves, the sensitivity is higher, but the upper frequency limit is lower. (Col. 1, line 65-Col. 2, line 4). The transducer comprises a hollow base containing a metallic backplate for defining a first electrode and having a grooved surface in contact with one surface of a plastic diaphragm stretched across the base, the other surface of the diaphragm being metallized for defining a

second electrode. There is an insulating layer 14A between diaphragm 14 and backplate 13. (Col. 7, line 7-12). The shallower grooves near the periphery of the backplate provides improved directional characteristics.(Col. 2, line 44-56).

B. PRIOR ART DISTINGUISHED

The following is a quotation of 35 U.S.C. § 103(a):

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1-2, 4, 7-9, 12-16:

Claims 1-2, 4, 7-9, 12-16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Haller in view of Schindel, alone or further in view of Stamm (US4192977).

The examiner suggests that Haller teaches fabrication and structure for a cMUT array as per Figs. 1C-1D including a support electrode 11, 14, incomplete support walls and isolation supports of thermal oxide 12, and a silicon nitride membrane 14. Also, the examiner suggests that while Haller does not specifically define cell or well cavity structures or 'posts', Haller states that the cMUT array is providing improvement of spaced membrane elements for broadband operation over support plate surface roughening heretofore practiced in association with ultrasound electrostatic transducers. Furthermore, the examiner suggests that in view of Schindel it would have been obvious to optimize frequency response by providing regular air pockets 4 effectively supported by posts i.e. remaining material either formed from below (non-insulating) or from above via etching of the dielectric insulation immediately below the membrane electrode since this was known to enhance broadband operation to higher ultrasound ranges over the prior backing plate roughening technique mentioned in both references.

In the alternative, the examiner suggest that while Haller do not specifically address charge distributions, it would have been obvious in view of Stamm to use projection spacer distribution in an ultrasound directional device since this assists in providing directionality to the main beam lobe.

Applicant respectfully disagrees with this characterization and respectfully traverses for the following reasons.

Claims 1, 7, and 15 are independent claims.

Claims 1 and 15

Independent Claim 1 and independent Claim 15 require that "at least one isolation post or area of insulating material is formed in said cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge".

Applicant respectfully submits that the cited prior art fails to disclose, teach, suggest, or motivate any need for this structure.

Haller shows a structure with a substrate 11 which forms one plate of a capacitor, a membrane including a nitride layer 13 and gold contact layer 14 forming the other parallel plate of the capacitor, and the remaining thermal oxide 12 that supports the membrane. Specifically, in Haller, there is a separate support (wall) element 12 between the backplate 11 and membrane 13/14. This separate support (wall) element 12 is different from the inventive isolation post in the current application that does not support or connect the backplate and membrane electrodes. Haller fails to teach or suggest an isolation post or area of insulating material formed in the cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge.

Even if the cMUT array shown in Haller does provide improvement of spaced membrane elements for broadband operation over support plate surface roughening heretofore practiced in association with ultrasound electrostatic transducers, it is a distinguishable point from using an isolation post or area of insulating material formed in the cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge in the current application. In this application, the cMUT array in Figure 3A-3G is shown as one way of implementing the capacitive ultrasonic transducers with isolation post.

Furthermore, the current application does not suggest to optimize frequency response by providing regular air pockets 4 effectively supported by posts i.e. remaining material either formed from below (non-insulating) or from above via etching of the dielectric insulation

immediately below the membrane electrode. Even if it would have been obvious to do the above (and applicant does not so admit that it would be) based on the suggestion that this was known to enhance broadband operation to higher ultrasound ranges over the prior backing plate roughening technique in view of Schindel, as suggested by the examiner, it is a distinguishable point from suggesting an isolation post or area of insulating material formed in the cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge.

Also, even if using projection spacer distribution in an ultrasound directional device does assist in providing directionality to the main beam lobe in view of Stamm, it is distinguishable from using isolation post or area of insulating material formed in the cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge.

Applicant therefore submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met and that the rejection of Claim 1 and Claim 15 should be withdrawn.

Claim 7

Independent Claim 7 requires "at least one post or area of dielectric isolation material in said cavity for limiting the deflection of said membrane during operation to prevent contact of the membrane with the support substrate during operation of the transducer and minimize accumulation of charge."

Although the specific language in Claim 7 differs somewhat from the language in Claims 1 and 15 as argued above, analogous arguments as discussed above regarding Claim 1 and Claim 15 also apply to Claim 7 because the cited art fails to disclose, teach, suggest, or motivate any need for Applicant's recited structure.

Accordingly, applicant therefore submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met and that the rejection of Claim 7 should also be withdrawn.

Claims 2, 4, 8-9, 12-14, 16

Dependent Claim 2 further limits Claim 1 or 2 in that the support electrode is a low resistance silicon support and the support walls are an oxide, and the membrane is silicon.

Dependent Claim 4 further limits Claim 1 or 2 in that at least one isolation post or area is carried by the membrane.

Dependent Claim 8 further limits Claim 7 in that the membrane material is selected from silicon, silicon nitride, sapphire or diamond.

Dependent Claim 9 further limits Claim 7 or 8 in that the posts or areas of dielectric isolation material are a dielectric isolation material.

Dependent Claim 12 further limits Claim 7 or 8 in that the posts or areas are formed on the membrane.

Dependent Claim 13 further limits Claim 7 or 8 in that the location of the posts or areas is chosen to optimize the frequency response of the transducer.

Dependent Claim 14 further limits Claim 13 in that the size, shape and height of the posts or areas is further chosen to optimize the frequency response of the transducer.

Dependent Claim 16 further limits Claim 15 with any combination of one or more posts or areas at any selected location with height, size and shape which prevents shorting between the electrodes during operation of the transducer and minimizes accumulation of charges.

Without admitting the propriety of the rejections, since applicant submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met for Independent Claims 1, 7, and 15, the rejections of the above dependent claims, that further add distinguishing limitation as listed above, has also not been met and should also be withdrawn.

2. Claim 3

Dependent Claim 3 further limits Claim 1 or 2 in that it requires at least one isolation post or area is carried by the support electrode. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Haller in view of Schindel, alone or further in view of Stamm as applied to claims 1 or 2 above, and further in view of Djuric.

The examiner suggests that whereas Haller does not specifically teach provision of an (electrical) isolation post carried by the support, it would have been obvious in view of Djuric

since as suggested by the examiner, the backing plate may be made smooth for adherence, whereas Schindel makes clear that the modern ultrasound electrostatic array constructs are evolved from the former.

Applicant respectfully disagrees. The rejection of Independent Claims 1, 7, and 15 under 35 U.S.C. 103(a) over Haller in view of Schindel, alone or further in view of Stamm is discussed above and applicant respectfully requested the withdrawal of the rejection. Claim 3 is a dependent claim on Claim 1, and thus the above discussion applies to Claim 3 as well.

Djuric shows an electret acoustic transducer structure. The transducer has a thin, low mass diaphragm 11 which is supported in close proximity to a backplate 13. The separators 15 are conventionally designated as posts. The electret layer 36 on top surface of the backing plate prevents shorting the transducer capacitance. (Col. 3, line 60-64). Even if Djuric were interpreted to teach or suggest that the backing plate may be made smooth for adherence, it is distinguishable from using an isolation post or area of insulating material formed in the cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge in the current application. In Claim 3, at least one isolation post or area is carried by the support electrode, whose function is similar to the backplate. Claim 3 does not suggest having a smooth backing plate for adherence.

Also, even if Schindel makes clear that the modern ultrasound electrostatic array constructs are evolved from other prior art, as suggested by the examiner, this does not make Claim 3 obvious because Claim 3 does not suggest either the same or the contrary as that suggested by the examiner.

Accordingly, applicant therefore submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met and that the rejection of Claim 3 should be withdrawn.

3. Claims 3, 5-16

Claims 3, 5-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haller in view of Schindel, alone or further in view of Stamm as applied to claims 1 or 2 above, and further in view of Muggli.

The examiner suggests that whereas Haller is silent as to post and area selection so as to minimize trapped ions, it would have been obvious in view of Muggli to choose isolation posts

34, 64 and interstitial areas associated therewith in order to avoid irregularly concentrated electric fields such as would be associated with trapped ions. With respect to claim 3, the examiner suggests that Muggli effectively teaches the providing of an insulating backing plate protrusion alternative to insulation of the membrane portion from above in order to preserve electrical isolation during deflection contacting of protrusions and membrane or backing plate. He also suggests that the size, shape and height in Muggli are all chosen to impact frequency response.

Applicant respectfully disagrees with this characterization and respectfully traverses for the following reasons.

Claims 7 and 15 are independent claims.

Claim 7

Independent Claim 7 requires "at least one post or area of dielectric isolation material in said cavity for limiting the deflection of said membrane during operation to prevent contact of the membrane with the support substrate during operation of the transducer and minimize accumulation of charge."

Applicant respectfully submits that the cited prior art fails to disclose, teach, suggest, or motivate any need for this structure. The rejection of Independent Claims 7 under 35 U.S.C. 103(a) over Haller in view of Schindel, alone or further in view of Stamm is discussed above and applicant respectfully requested the withdrawal of the rejection.

Applicant respectfully disagrees with the examiner's characterization that projections 34 and layer 64 are "isolation posts" to avoid irregularly concentrated electric fields such as would be associated with trapped ions. In Muggli, there is a separate insulating layer 14A between diaphragm 14 and backplate 13, and grooves on the backplate (projections 34 and layer 64) apparently maximize radiation of acoustic energy at frequencies in the range 5 to 80 kHz at atmospheric pressure (Col. 2, line 8-10), which is similar to the relationship of surface condition and frequency response found in Haller. And the shallower grooves near the periphery of the backplate apparently provide improved directional characteristics. However, these grooves are distinguishable from the isolation post in the current application which provide isolation between the backplate and membrane electrodes and also replace the isolation layer to reduce charge accumulation.

Applicant therefore submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met and that the rejection of Claim 7 should be withdrawn.

Claim 15

Independent Claim 15 require that "at least one isolation post or area of insulating material is formed in said cavity to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge."

The same arguments as discussed above regarding Claim 7 also apply to Claim 15.

Accordingly, applicant therefore submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met and that the rejection of Claim 15 should be withdrawn.

Claim 3

Dependent Claim 3 further limits Claim 1 or 2 in that at least one isolation post or area is carried by the support electrode. Dependent Claim 2 depends on Independent Claim 1.

The same arguments as discussed above regarding Claim 7 also apply to Claim 1, thus to the dependent Claim 3.

The examiner also suggests that Muggli effectively teaches the providing of an insulating backing plate protrusion alternative to insulation of the membrane portion from above in order to preserve electrical isolation during deflection contacting of protrusions and membrane or backing plate.

Applicant respectfully disagrees with the examiner's characterization that projections 34 and layer 64 are "insulating backing plate protrusion". In Muggli, there is a separate insulating layer 14A between diaphragm 14 and backplate 13. The grooves on the backplate (projections 34 and layer 64) apparently maximize radiation of acoustic energy at frequencies in the range 5 to 80 kHz at atmospheric pressure (Col. 2, line 8-10), which is similar to the relationship of surface condition and frequency response found in Haller. And the shallower grooves near the periphery of the backplate apparently provide improved directional characteristics. However, these grooves are distinguishable from the isolation post in the current application which provide isolation between the backplate and membrane electrodes and also replace the isolation layer to reduce charge accumulation.

Accordingly, applicant therefore submits that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met and that the rejection of Claim 3 should be withdrawn.

Claim 5, 6, 8-14, 16

Dependent Claim 5 further limits Claim 1 or 2 in that isolation posts or areas are located at selected locations with the size, shape, and height selected to prevent shorting between electrodes and minimize the number of trapped ions.

Dependent Claim 6 further limits Claim 1 or 2 in that the height, shape and location of the posts or areas is selected so that the membrane comes in contact with the posts during post contact operation of the transducer.

Dependent Claim 8 further limits Claim 7 in that the membrane material is selected from silicon, silicon nitride, sapphire or diamond.

Dependent Claim 9 further limits Claim 7 or 8 in that the posts or areas of dielectric isolation material are a dielectric isolation material.

Dependent Claim 10 further limits Claim 9 in that the walls of insulating material are a dielectric isolation material.

Dependent Claim 11 further limits Claims 7 or 8 in that the posts or areas are formed on the support substrate.

Dependent Claim 12 further limits Claim 7 or 8 in that the posts or areas are formed on the membrane.

Dependent Claim 13 further limits Claim 7 or 8 in that the location of the posts or areas is chosen to optimize the frequency response of the transducer.

Dependent Claim 14 further limits Claim 13 in that the size, shape and height of the posts or areas is further chosen to optimize the frequency response of the transducer.

Dependent Claim 16 further limits Claim 15 with any combination of one or more posts or areas at any selected location with height, size and shape which prevents shorting between the electrodes during operation of the transducer and minimizes accumulation of charges.

Applicant submitted that the standard for demonstrating obviousness under 35 U.S.C. § 103 has not been met for Independent Claim 7 in the above discussion. Since the same

argument applies to Independent Claims 1 and 15, the rejections of the above dependent claims, that further add limitation as listed above, should be also withdrawn.

Regarding Claim 14, even if the size, shape, and height of the backing plate projection can be changed to impact frequency response in Muggli as the examiner suggested, the projection is distinguishable from using isolation post(s), which limit the deflection of membrane during operation to prevent contact of the membrane with the support substrate during operation of the transducer, minimize accumulation of charge, and optimize the frequency response of the transducer. In Muggli, there is a separate insulating layer 14A between diaphragm 14 and backplate 13. In the current application, the isolation layer is absent because the isolation post prevents contact of the membrane with the support substrate during operation of the transducer.

As discussed above, there is no teaching, suggestion, or motivation in the cited art of using isolation post or area of insulating material formed in the cavity, to prevent contact of the membrane electrode to the support electrode during operation of the transducer and minimize accumulation of charge. The frequency response optimization using isolation posts that limits the deflection of the membrane during operation is also distinguishable from the frequency response of the cavity based on the surface condition (grooved or roughened patterns). Even if the teaching could be inferred from one of the prior art references, it would not have been obvious to one of ordinary skill in the art at the time the invention was made based on the above discussion.

Furthermore, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure (MPEP 2143). *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). There is no such suggestion or motivation for the claimed combination found in the prior art, nor is there such expectation of success in the prior art.

CONCLUSION

In view of the foregoing, it is respectfully submitted that the claims of record are allowable and that the application should be passed to issue. Should the Examiner believe that the application is not in a condition for allowance and that a telephone interview would help further prosecution of this case, the Examiner is requested to contact the undersigned attorney at the phone number below.

The Commissioner is authorized to charge any fees that may be due as a result of filing this amendment, including additional claims fees not already paid for, fees for Extension of Time, or other fees that have not been separately paid, to Deposit Account 50-2207 (Order No. 33683/US (468330-1807)/(60849-8011-US01)).

Applicant submits the claims are in condition for allowance, and notification of such is respectfully requested. If after review, the Examiner feels there are further unresolved issues, the Examiner is invited to call the undersigned at (650) 838-4300.

Respectfully submitted,
Perkins Coie LLP

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